NOTE ON A LABYRINTHODONT FOSSIL FROM COCKATOO ISLAND, PORT JACKSON.

By Professor Stephens, M.A., F.G.S.

The circumstances under which this very interesting fossil was discovered and obtained are sufficiently curious to merit some notice. And perhaps such notice may serve to give fresh encouragement to those who had begun to despair of finding any satisfactory evidence as to the epoch of our Hawkesbury formation, and may prevent the careless destruction of such evidence as will from time to time be unearthed in the ordinary processes of quarrying.

It is to the quick eye of Mr. Maiden, the energetic Curator of the Technological Museum, that we owe, in the first instance, the very important discovery which has now been made. Mr. Fagan, an engine-driver employed on the works of the new Dock at Biloela, or Cockatoo Island, had heard from one of the labourers that some "funny things" had just been dislodged by a blast in the process of excavation. One of these "funny things," a very large *Planorbis*, or some closely allied form, he obtained, and handed to Mr. Maiden, who most unfortunately was, the very next day, attacked by a severe and dangerous illness. On his recovery, some weeks afterwards, he communicated with Mr. C. S. Wilkinson, Government Geologist, showing him the supposed *Planorbis*, and informing him of the occurrence of other fossils in the same locality. Mr. Wilkinson at once despatched his best "fossil-hunter," Mr. C. Cullen, to the place, who found that the greater portion of the find, a whole truck load, had been shot down into the waters of the harbour, and covered up by great quantities of less interesting material. He picked up, however,

one block of sandstone which had an unusual and evidently important impression of some organic structure. The stone itself was a rough conglomerate, with some large holes where pebbles had fallen out, and a few fragmentary pieces of shale still embedded.

When Mr. Wilkinson showed me the specimen, I recognised it at once as a thoracic or throat-plate of *Mastodonsaurus*—probably *M. robustus*, or at least very closely related to that species,—in consequence of its exact resemblance to the fossil from the University collection which lies beside it on the table. We have not the material here for an exact determination such as will be made in England; but there is and can be no question as to the Labyrinthodont character of the fossil, nor, as I believe, as to its identification with some species of *Mastodonsaurus*.

Now many considerations had induced the geologists of India and Australia to class upon the same horizon the rocks of the Upper Gondwana of India, the Upper Karoo beds of South Africa and the Hawkesbury-Wianamatta beds of East Australia, with, the Keuper and Rhætic or Upper Triassic beds of Europe.

But the evidence so far as Australia was concerned was not quite satisfactory, although increasing year by year; and I cannot but think it a very happy coincidence that this Amphibian should have turned up immediately after Mr. Oldham's papers upon this subject in the Geological Magazine. I do not intend to enter at present into any arrangement of the facts which have been already ascertained, since I am sure far more competent hands will soon be at work upon the subject. There are, however, a few points to which I may draw your attention with reference to the distribution of the Amphibia, and the early Mesozoic Geography of Australasia and New Zealand.

It was remarked many years ago by Darwin, that these animals, Batrachia or Amphibia, had a very closely restricted distribution. They are not able to bear contact with salt-water, and are consequently absent from almost all oceanic islands. And of the four great orders into which the class is divided, only one is at

present known in the Australian province. We have no Newts or Salamanders, nor any Blindworms (*Cæcilia*) at present, nor have we any fossil records of their previous existence. But we have now two distinct types of Labyrinthodonts from Australia, one—*Bothriceps*, described by Professor Huxley, from a skull, of which the locality is unknown, except that the fossil was found somewhere in Australia. The other—the plate now before us.

It is clear that during the period when these animals made their way into this region, there must have been an unbroken land communication between India and Australia; and it seems likely that it was during this time that *Ceratodus*, and perhaps *Osteoglossum*, immigrated. *Ceratodus* and *Mastodonsaurus* are found constantly associated in beds of the same age.

Perhaps the ancient land-connection between N.E. Australia, Lord Howe Island, Norfolk Island, New Zealand, New Caledonia, and which extended to Indo-Malaya, as has been beautifully shown by Mr. Wallace in his "Island Life," may have been severed in very early Mesozoic times. And it is possible that some of our singular forms of life, recent and fossil, may have been introduced at an earlier period than is generally thought probable. Indeed I think that the presence of *Megalania* in both Australia and Lord Howe Island, and the relationship of the New Zealand *Hatteria* to *Hyperodapedon*, together with all the remarkable peculiarities of the Australian Fauna, seem to point in that direction.

Although any exact determination of the true character of our interesting discovery is not under present circumstances possible in this quarter of the globe: yet it may be of some service, in case of similarly happy accidents in the future, to indicate the principal sources from which information as to the ancient habitats and forms of Labyrinthodonts may be obtained. And first there are the two reports edited by Mr. Miall, and published in the Reports of the British Association for 1873 and 1874, which contain a summary of everything known up to that time. Later information as to the bibliography of the subject will be found

in Palæontologia Indica (Ser. IV, Vol. I, Parts 4 and 5). The attention however of the committee thus represented by Mr. Miall was principally directed to the skull, which is in general the most perfectly ossified, and therefore the most successfully preserved (in the very rude methods which nature adopts) of all portions of the skeleton. The *Bothriceps* of Huxley, from some undefined part of Australia, is also known only by the head ; and it will therefore be very difficult to make out the true relations of our fossil unless, as I have already said, it may be determined as a *Mastodonsaurus*. In Pictet's classical work on Palæontology, published indeed a long while ago, in 1853-7, we find in plate XXIX. fig. 6, "Piéces scapulaires de la même espèce" (*Mastodonsaurus* or *Capitosaurus robustus*) "un douzième de la grandeur naturelle." The figure, justly enlarged, corresponds so closely with our specimen that I cannot doubt their practical identity. It was the presence of the fossil in the University collection, here shown, from Stuttgart, that led me in the first instance to inquire what function it could have fulfilled in the living animal, and it was Pictet who gave me the desired information. He states in the text that "*Capitosaurus robustus* H. de Meyer, a été trouvé dans les étages supérieurs du Keuper, pres de Stuttgardt, M. Quenstedt pense qu' on doit réunir aux Mastodonsaurus." Quenstedt's view seems to be accepted ; but the whole group still presents many and serious difficulties. When Professor Owen first identified *Cheirotherium* and *Labyrinthodon*, a great puzzle seemed to have been solved. But perhaps there are no grounds for this identification ; it is quite as probable that the famous foot prints were made by a reptile as by an amphibian ; and we have actually no trustworthy evidence at all as to the character of these antiquated creatures' limbs. Some were very likely, like *Dolichosoma*, quite destitute of these appendages ; others, like *Archegosaurus*, certainly possessed them. But how they moved with them in the warm swamps or rivers which they seem to have frequented, we do not know, nor have we reasonable grounds for conjecture.

This at least we may now assert of the Hawkesbury formation, that if it had, as Mr. Wilkinson's observations render probable, a glacial period, it had also one or several eras of genial warmth and moisture. The *Planorbis* to which reference has been already made, the Unionidæ which have been discovered in the Wianamatta rocks, the highly carbonaceous and even bituminous character of much of the Parramatta and Kenny Hill Shales, and still more emphatically the extraordinary plant from the Parramatta River, described by Baron von Müller as *Ottelia prætorita*, (Jour. Roy. Soc. N.S.W., 1879, p. 95), and a large fruit recently obtained by Mr. Wilkinson, demonstrate this. Now here is another singular correspondence between our Hawkesburys and the Trias of Europe.

Both in the preceding (or Permian period) to which our Newcastle coal is reasonably referred, and in the Triassic we find, all over the world, evidences of ice. And at the same time we find in the organic remains abundant evidence of heat. It can hardly be doubted by any unprejudiced person that both these periods, whose records testify to enormous and now-a-days unparalleled changes in all plant and animal life, were also times of enormous and perhaps unparalleled change of climate, during which northern forms were driven to the south, with vast loss not only of individuals, but of species, to be driven back again in the course of another ten thousand years or so, losing on their road the greater portion of their whole army. This is the true solution of the strange break between the Palæozoic and Mesozoic time, and is strongly corroborated by the fossil now before us; while Dr. J. Croll has demonstrated the fact on different grounds.

When this family lived and flourished somewhere north of the equator, with *Hyperodapedon*, *Ceratodus*, and other contemporaries, cold and inclement seasons began to increase their severity; and as the Labyrinthodont clan were entirely carnivorous, they had to travel south after their food, since it also had its own power of locomotion. And so—after thousands of years—they found themselves in South Africa, South America, India, and Australia; and

subsequent reversal of all climatic conditions drove them in course of time northwards again. But probably they met with arms of the sea, or some other obstructions which interfered with their return march, and they disappeared from the earth. They appear suddenly as the very highest type of Amphibia in the Carboniferous period, and by the incoming of the Liassic they are lost. (A doubtful exception I take the liberty to disregard). They were, among the frogs and their compeers, like crocodiles among lizards, various in size, sometimes gigantic, slow perhaps, but powerful, and bent on devouring.

I ought not to omit—though it is not perhaps a very strong point in evidence—the occurrence of very similar, if not identical forms of a small fossil Entomostracon, *Estheria* sp. in the Indian Upper Gondwana, the Argentine District of South America, and the Australian Waianmatta. I have seen the small bivalve carapace from the borings at Moore Park, through Dr. Cox's kindness, and I have also found them near Campbelltown. The same genus—I dare not say species—is quite common in the Triassic and Rhætic beds in England, and upon the continent of Europe.

And so one draws to the conclusion that the older school of geologists was right in the assumption that similar Faunas testify to contemporaneous epochs. Much has been said and written against this view; and the present distribution of animal and vegetablelife upon the globe is the very strongest—and indeed it is very strong—weapon of the assailants. Still, when you find the petrological characters alike, when you discover *Unionidæ*, *Palæoniscus*, *Cleithrolepis*, *Platysomus*, *Mastodonsaurus* as fossils, and *Ceratodus*, *Hatteria*, Marsupials, and Monotremes still living in the same province, you are, or at least I am, driven to believe that the old view was right, and that it is only since the Jurassic period that the great geographical differentiation of Plants and Animals commenced.

I ought perhaps to have commenced by stating what part of the animal we see preserved upon the stone. But I am a little

diffident in the matter, and though my own conviction is strong, I feel that others may form very different views. However, the facts are as follows :—All the Mastodonsaurus group of the Labyrinthodonts, and some others, possessed a very curious breast armour, perhaps in compensation for the slight and poor development of the pectoral arch in the true skeleton. The plates of which this armour or breastplate was formed have often been mistaken for Chelonian remains ; but are remarkably well characterised by the deep, long, and bifurcating or reticulated channels which are ordinarily called muciferous canals. Of these plates they had three—one rhomboidal in shape, medial and posterior, upon the lower portion of the throat, and two lateral and forward, slightly overlapping the medial, and compared by Owen—in *Archegosaurus*—to the elytra of a beetle. One of these is now, I believe, before you.

In conclusion I beg to be allowed to quote, from the Memoirs of the Geological Survey of India, a few passages which are certainly curious, and which I think bear out—so far as such evidence can—the identity of our upper coal measures and Hawkesbury with the Damudas of India. We have the same conglomerates, the same false bedding of the sandstone, and now at last the satisfactory declaration of *Mastodonsaurus*,

In the report on the Karanpura Coalfield, Mem. Geol. Survey, VII. 3, Mr. Hughes says—of the Upper Damudas, appearing like Panchets—"In many places the rocks have been weathered in the most peculiar manner. Small pinnacles and domes are left here and there, and their whole surface presents the appearance of successive irregular circles of little scallop-shaped recesses." "This weathering is more particularly apparent in those portions of sandstone which stand up prominently in the shape of domes or pinnacles."

No one who is acquainted with Hassan's Walls, or any similar district on the edge of the Hawkesbury sandstone can fail to see the exactness of this description, if transferred to this country.

Mr. Mallet again, Mem. Geol. Surv. Ind. VII. 1, gives an account of the escarpments with which he was concerned, which will precisely fit our Blue Mountains. The same author gives an admirable account of the process of erosion by which the sandstone valleys have been excavated.

Again, Mr. Blandford (Pal. Ind. Ser. IV, Vol. I, Part 1, p. ii.) describes the Panchet beds as follows :—

"The Panchet beds consist mainly of alternations of fine red clay and of coarse sandstone. The beds of the former are thin, rarely exceeding 12 feet in thickness, and continuous over considerable areas ; the latter are sometimes above a hundred feet thick, most irregularly and obliquely laminated, and evidently deposited by water flowing with a strong current. The component particles of the sandstones are principally grains of quartz and of undecomposed felspar, with numerous plates of mica, all evidently derived from the metamorphic rocks. These sandstones are rarely conglomeritic ; the pebbles, when they do occur, comprise fragments of coal, shale, &c., derived from the Damuda series. Towards the base of the Panchets, fine muddy silts and shales occur. Towards the top conglomerates are more frequent. Organic remains are scarce throughout. The whole thickness of the series, excluding some overlying coarse ferruginous sandstones and conglomerates, which probably belong to a higher formation, is at least 1,500 feet.

"It was in one of the more conglomeritic bands, an argillaceous sandstone with pebbles of shale and of other rocks, and occurring about 500 feet above the base of the series, that the bones now described were found. They were invariably detached, even single teeth being met with ; the jaws were fragmentary, and many of the bones had been rolled and rounded. In addition to the first locality at Deoli, other spots yielding fossils were subsequently found, all apparently at the same general stratigraphical horizon, and probably in the same bed, which was traced by Mr. Tween for a considerable distance. The other fossils met with in the Panchet beds were a few plants and some *Entomostraca*, the most abundant of which was an *Estheria*, apparently. *E. Mangaliensis*, R. Jones.

"Independently of the presence of the *Estheria*, which has been shown by Professor Rupert Jones to be essentially a fresh (or brackish) water genus, there can he little doubt that all the beds of the Rániganj field were deposited in fresh water, and I believe the larger portion to have been the valley or alluvial deposits of a great river. The total absence of marine remains, and of mollusca of any kind, the extreme rarity of limestone, the constant traces of rapid currents shown by the oblique lamination of the sandstone, all favour this view. Lacustrine or estuarine conditions may perhaps have prevailed during the deposition of the Talchirs and of the basement beds of the Panchets, possibly even of the Damudas (though of this I am extremely doubtful), but I am convinced that the mass of the Panchet beds are a fluviatile deposit. The universal evidence of current actions in the sandstones precisely resembles those which may happen in the valley deposits of the great Indian rivers, in which also stratification of fine clay is frequent, while the first named phenomenon is totally inconsistent with deposition in lakes of any size. The recent distribution of Estheria and similar crustacea, especially in India, is in favour of their Panchet prototype having been an inhabitant of shallow pools, rather than of extensive deep basins of fresh water. Large marshes, more or less permanent, frequently disappearing almost completely during the dry season, abound in the valleys of large rivers, indeed after heavy rains the greater portion of the river-valley becomes an immense marsh, in which fine clays may accumulate.

"During how great a period of geological time even small rivers may occupy the same valleys has been shown by Mr. H. B. Medlicott, in his memoir on the Sub-Himalayan rocks, and when it is borne in mind that it is only in periods of general subsidence, continuous or intermittent, that strata can be accumulated in river valleys, it is easy to conceive that a mere discontinuance of movement during a geological period may suffice to cause such changes as are observed between the Talchir and Damuda, and between the latter and the Panchet series; while, unless elevation has taken place, but little denudation will have been caused."

Though these extracts are very long, yet they cannot but be interesting to us, especially as regards the question of ancient climates.

(*Note.*—The general absence of shells is a remarkable peculiarity of the recent fluviatile deposits of India, mollusca abounding in all its rivers.)